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THE SUNFLOWER AND ITS INSECT VISITORS

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The sunflower, *Helianthus,* belongs to about the largest, most uniform, and most commonplace of the natural families. Compared with the Compositae in general (3 and 5 in table), it shows a higher percentage of bee species and a higher percentage of bee visits, as well as a higher percentage of species of Lepidoptera, and a lower percentage of other insects. This is because the corolla tubes are deeper than in the average Compositae. It resembles rosin-weed, *Silphium* (4 in table). Of the 655 species found on Compositae at Carlinville 21.8 percent occur on *Helianthus.* It forms 9.4 percent of the local Compositae and shows 8.1 percent of the insect visits.

Table. *Visits of insects to flowers of* Compositae, *by species of insects and number of visits*

List		Bees alone		Bees and other insects					Total number
		Long-tongued bees	Short-tongued bees	Bees	Dipt.	Hym.	Lep.	Col. Hem.	
		In percentages of all insects		Percent					
1. Carlinville, 1894, 1898..........	Species....	37.1	16.4	53.6	18.5	4.1	18.5	5.1	97
	Visits......	40.9	16.1	57.1	21.7	2.4	14.4	4.3	161
2. 23 other localities.	Species....	45.3	25.3	70.6	6.6	......	20.0	2.6	75
	Visits......	47.9	25.0	72.9	5.2	......	18.7	1.0	96
3. Present list......	Species....	34.9	18.1	53.1	19.5	6.9	13.9	6.1	143
	Visits......	42.1	20.0	62.1	18.1	3.7	10.0	5.8	320
4. *Silphium*........	Species....	37.3	13.3	50.6	18.6	4.0	26.6	......	75
	Visits......	51.1	12.4	63.5	16.2	3.1	17.0	......	129
5. Compositae......	Species....	14.3	15.1	29.4	30.3	23.8	10.2 11.6	6.1	655
	Visits......	23.4	17.3	40.7	27.3	17.5		2.7	3,905
6. *H. annuus* and *divaricatus*.......	Species....	51.3	16.2	67.5	10.8	2.7	13.5 12.2	5.4	37
	Visits......	55.1	14.2	69.3	10.2	2.0	2.7	6.1	49
	Individuals	71.9	14.1	86.0	8.3	0.2	11.1	2.5	467
7. *H. annuus*.......	....	52.7	22.2	75.0	8.3	......	10.4	5.5	36
7 wild species.....	....	43.6	19.7	63.4	18.6	4.4	......	2.9	268
8. Alfken's list......	Species....	92.8	0.0	92.8	......	......		7.1	14
Others' lists......	Species....	28.5	4.7	33.3	47.6	......	4.7	14.2	21
	Visits......	41.6	2.7	44.4	44.4	......	2.7	8.3	36

The tubes are about 6 mm. deep. Since small insects can thrust their heads a little way into the tubes, and since nectar rises in the tubes, we may expect to find on the flowers almost any anthophilous insects with tongues 4 or 5 mm. long and upwards. *Helianthus* is therefore adapted to rather long-tongued bees and other insects. The miscellaneous character of the long-tongued visitors is shown by the following percentages of the local insects, the second figure being for species flying while *Helianthus* is in bloom: Bombidae, 88.8, 88.8; Megachilini, 50.0, 53.3; *Coelioxys,* 83.3, 83.3; *Triepeolus,* 81.8, 81.8; *Melissodes,* 52.3, 55.5; or in general: Megachilinae, 59.0, 61.9; Epeolidae, 66.6, 75.5; total long-tongued bees, 35.6, 53.6—Halictidae (ex. Sphecodini), 30.2, 34.2; Panurgidae, 37.5, 37.5; Andrenidae, 5.8, 33.3; total short-tongued bees, 18.0, 28.1—total bees, 26.6, 40.9—Rhopalocera, 25.3, 29.3—Bombyliidae, 45.4, 55.5.

According to my present list the following 23 are the most regular visitors at Carlinville, occurring at least on four out of eight species:

Long-tongued bees (11:67)—BOMBIDAE: *Bombias separatus* 6, *Bombus americanorum* 7; MEGACHILIDAE: *Megachile brevis* 5, *Sayapis sayi* 5; *Xanthosarus latimanus* 7; EPEOLIDAE: *Triepeolus concavus* 7, *T. cressonii* 4; EUCERIDAE: *Epimelissodes obliqua* 8, *Melissodes agilis* 7, *M. coloradensis* 6, *M. trinodis* 5.

Short-tongued bees (5:26)—HALICTIDAE: *Chloralictus pilosus* 5, *Odontalictus ligatus* 6; DUFOUREIDAE: *Halictoides marginatus* 4; ANDRENIDAE: *Pterandrena helianthi* 5, *P. pulchella* 6.

Diptera (5:27)—SYRPHIDAE: *Eristalis transversus* 6; BOMBYLIIDAE: *Anthrax halcyon* 4, *Exoprosopa decora* 4, *Sparnopolius fulvus* 7, *Systoechus vulgaris* 6.

Lepidoptera (1:5)—PIERIDAE: *Eurymus philodice* 5.

Coleoptera (1:5)—LAMPYRIDAE: *Chauliognathus pennsylvanicus* 5. The list shows 17.4 percent of the legitimate visitors making 42.7 percent of the legitimate visits.

My local lists[1] show 161 visits made by 97 species of insects (1 in table). The present list shows 143 species making 320 visits (3 in table). Six local species have been noted by other observers, so that 149 local insects have been found on *Helianthus.* Lists of visitors from other localities might differ for the following reasons:

1. The observers did not take the trouble to note all of the insects occurring or to make a careful list.

2. The plants may have formed poor patches not surrounded by the original flora and not exposed to the original insect fauna. Cultivated species like *H. annuus* are likely to be very unfavorably situated in this regard. It is about as futile to observe such plants as to trifle with those more favorably placed. Data made under such conditions belong to pseudecology. *H. annuus* growing in my yard within about a quarter of a mile of wild species,

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[1] "Flowers and Insects—Rosaceae and Compositae," Trans. Acad. Sci. St. Louis **6**: 469–71, 1894, and "Flowers and Insects," XVIII, Bot. Gaz. **25**: 244–5, 1898.

and observed on 29 days, showed too many bees, Coleoptera, and Hemiptera and was short on Diptera and other Hymenoptera (7 in table, based on legitimate visits). On the 7 wild species Diptera always show at least 16.6 percent of the visitors.

3. The plants may have been exposed to quite a different insect fauna. Differences in species and genera are to be expected, but are rather trivial.

Since the 1894, 1898 lists were published observations by 13 persons in 23 different localities have been recorded. Of the visitors which they mention 26.6 percent have been observed at Carlinville. Their fragmentary nature is shown by several facts. They give 75 visitors and 96 visits, an average of 4.1 visits for each locality and 7.3 for each person (2), while the 1894, 1898 lists give 97 visitors and 161 visits (1). In 35.8 percent of the species and 35.7 percent of the visits the sexes of the bees are not given. When the sexes are given the host bees are indicated as collecting pollen in only 12.1 percent of the species and 9.0 percent of the visits. The Carlinville list shows them collecting pollen in 57.5 percent of the species (71.9 in present list) and 47.8 percent (60.6 in present list) of the visits: long-tongued bees 67.7 percent of the species and 45.5 percent of the visits, short-tongued bees 73.0 percent of the species and 84.3 percent of the visits. These lists exaggerate the importance of bees and Heterocera and underestimate the importance of Rhopalocera and Diptera.

As data of anthecology collectors' notes are likely to prove worthless, because the collector naturally looks out for particular kinds of insects and is not interested in ascertaining what kinds of insects occur on the flowers, or their relative frequency. As entomological data they are equally worthless, because collectors select flowers on which the desired insects are most likely to occur, and they almost invariably fail to note what the insects are after.

The difference between anthecological data and collectors' notes is pretty well shown by the *Helianthus* lists in Knuth's Blütenbiologie. Alfken's list shows bees 92.8 percent, while the lists of Müller, Knuth, and Loew show: bees species 33.3 percent, visits 44.4; flies species 47.6, visits 44.4 (8 in table). These authors found flies on 7 out of 9 species, while Alfken records none.

As entomological data the differences in the two sets are just as striking. To the flower visits of Diptera, Alfken's list contributes nothing, while the other lists contribute just as many Diptera visits as bee visits.

It is interesting to note that Knuth, in his handbook "based upon Hermann Müller's work," prints Müller's lists for the third time, introduces collectors' notes which ignore Müller's method, and suppresses American lists which follow it. Knuth gives fragmentary observations made in Europe where *Helianthus* is cultivated and suppresses pretty extended lists made in America where it is indigenous. He suppresses French and Italian insect-collectors' notes on the ground that it would require too much labor to collate them, but he suppresses American anthecological lists evidently for a different reason.

Sometimes *Chauliognathus pennsylvanicus* fairly swarms on the flowers of *Helianthus* and at other times *Sparnopolius fulvus* is just as abundant, but these cases do not indicate the usual conditions. It would be a mistake for a casual observer to infer that such a condition was regular for any locality.

In the long list of miscellaneous visitors *Halictoides marginatus,* which gets its pollen exclusively from the flowers, is the only one entitled to be designated as a *Helianthus* insect.

Apis mellifera is the most regular visitor recorded in different lists. Of 196 visits observed at Carlinville, 28.5 percent are to Compositae. Of 105 visits observed after June, 44.7 percent are to Compositae. Of 153 individuals taken in my yard on *H. annuus,* in 1917, *Apis* showed 40.5 percent. Of 467 individuals (6 in table) taken on *H. annuus* and *divaricatus* it showed 14.1 percent.

Megachile (1894, 1898) forms 11.3 percent of the species and makes 8.0 percent of the visits. Of the local species flying when *Helianthus* is in bloom these lists show 53.3 percent. My present list shows 59.0 percent of the species, 61.9 of those flying in the *Helianthus* season.

The statement that the bumblebees occurring on *Helianthus* are principally males is not supported by any observations. Visits of bumblebees (1894, 1898) show: ♂ 52.3 percent, ♀ 38.0; and in the present list: ♂ 47.2, ♀ 44.4. Of 94 individuals taken on *H. annuus* 74.4 percent were workers and 25.5 males. The workers, which are after nectar and pollen, are more apt to occur than the males which are after nectar. The occurrence of the male establishes a presumption that the worker of the same species also occurs on the flowers. Of 261 visits of bumblebees to Compositae, observed only after June, 48.6 percent were made by the workers and only 40.2 by the males.

That there is a general absence of butterflies as sunflower visitors is not supported by any reliable observations. Butterflies (1894, 1898) are 15.4 percent of the species, making 12.6 percent of the visits. Of local species 25.6 percent were found on *Helianthus,* 37.3 percent of those flying in the blooming season. *Helianthus* will probably show 25 percent of the Rhopalocera in any locality where it is indigenous. These flowers belong to a class particularly preferred by butterflies, general social flowers with deep-seated nectar, Mas, as shown in the following 1,407 visits observed at Carlinville:

	Non-social		Social			Total
	Ma	Mi	Mas	Mis	Pol	
Flowers observed..........	30.1	24.2	18.8	21.5	5.2	441
Rhopalocera visits.........	16.2	10.0	42.5	22.6	8.5	1407

Mas forms 18.8 percent of the flowers observed and receives 42.5 percent of the butterfly visits.

The Heterocera (1894, 1898) show 3.0 percent of the species and 1.8 percent of the visits. For 143 species and 320 visits the percentages are 2.0 and 1.2. A correct list is not likely to show much difference in any locality. They are not likely to occur in abundance at the time of day when *Helianthus* pollination is usually effected.

Of local families the Megachilidae is the only one showing over 10 percent of the species (10.5 percent). The Euceridae, Megachilidae, and Halictidae show the following percentages of the visits: 13.1, 10.6, 10.3. Of 467 individuals (6 in table) taken on the flowers the following showed these percentages: *Bombus americanorum* 27.4, *Apis mellifera* 14.1, *Odontalictus ligatus* 10.9, *Melissodes agilis* 10.4; Bombidae 37.6, Euceridae 17.9, Halictidae 13.7.

When flowers like *Helianthus,* adapted to miscellaneous long-tongued insects and blooming from July 6 to October 15, show 143 species observed by one person in one locality, it is easy to see that the number actually occurring might be quite different from what this one observer saw. It is also easy to see that the flowers ought to show more than an average of 4.1 in 23 other localities. If these 4.1 visitors are made a basis of generalization, the conclusion may be drawn that *Helianthus* is visited by different kinds of insects in different localities. Unless the flowers were observed under normal conditions about every other day during the season and showed at least about 100 visitors, it would hardly be reasonable to accept the conclusion that the visitors are essentially different from those observed at Carlinville. Even then it ought to be shown that the composition of the insect fauna is different.

A final result of observations in different indigenous localities would be that, *of insects flying in the blooming time, Helianthus* would show about 53.6 percent of the long-tongued bees, 28.1 of the short-tongued bees, 29.3 of the Rhopalocera, and 55.5 of the Bombyliidae—sooner or later about all of the North American long-tongued anthophilous insects.